

# Air Pollution and Childhood Respiratory Allergies in the United States

March 26, 2009



Thank you Mr. Goldstene. Good morning, Madam Chair and members of the Board. In this health update, I will provide a brief summary of a recently published study that showed an association between air pollution exposures and childhood respiratory allergies.

## Background

- Respiratory allergies
  - Common chronic condition in children
  - Contribute to school absences
- Environmental factors may worsen symptoms
- Association between air pollution and childhood allergies studied in Europe and Asia
- Today's health update – 1<sup>st</sup> large nationwide study\*



\*Jennifer D. Parker, Lara J. Akinbami, and Tracey J. Woodruff. 2009. Air Pollution and Childhood Respiratory Allergies in the United States. *Environmental Health Perspectives* 117(1):140-147. Supported by the National Center for Health Statistics (Centers for Disease Control and Prevention) and the Office of the Assistant Secretary for Planning and Evaluation.

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Respiratory allergies are a common chronic condition in children. There appears to be a wide variation in prevalence; however, it is estimated that up to 40% of U.S. children are affected by allergic rhinitis, which includes hay fever and other respiratory allergies.

Respiratory allergies also contribute to school absences and activity limitations.

It is thought that environmental factors, including air pollution, may play a role in the worsening of respiratory allergy symptoms.

Associations between air pollution and childhood allergies have been reported in studies conducted in Europe and Asia, but there has been some variability in the results. This may be due to location-specific effects, such as the presence of different types of pollen and other allergens. Thus, it is important to determine the effects of air pollution on childhood allergies in the U.S. However, comprehensive studies conducted in this country have been lacking up to now.

Today's update will focus on a recent publication by Jennifer Parker, of the National Center for Health Statistics, and colleagues. Their study is the first to examine a large nationwide sample of U.S. children and their respiratory allergies with respect to air pollutant exposures.

## Methods

- 72,279 children, ages 3-17
  - 7.6% from Southern California
- Air pollutant data
  - Annual averages for PM<sub>2.5</sub>, PM<sub>10</sub>, NO<sub>2</sub>, SO<sub>2</sub>
  - Ozone summer averages
- Controlled for race/ethnicity, age, sex, and other factors



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There were over 72,000 children, ages 3 to 17 years, in this study. The households in which these children lived were sampled as part of the National Health Interview Survey between the years 1999 and 2005.

Almost 8% of these children lived in Southern California.

Air pollutant monitoring data used in the study were taken from the U.S. EPA's Air Quality System.

Annual averages for PM<sub>2.5</sub>, PM<sub>10</sub>, nitrogen dioxide, and sulfur dioxide were examined in combination with the health survey data. Ozone averages were examined for the summer months only, when ozone levels are typically high.

The analysis controlled for the children's race/ethnicity, age, sex, and a number of other factors.

## Results

- 19.2% had hay fever and/or respiratory allergy
- Ozone: for every 10 ppb increase, likelihood of allergy exacerbation increased by 20%
- PM2.5: for every 10  $\mu\text{g}/\text{m}^3$  increase, likelihood of allergy exacerbation increased by 16%
- Greater ozone effect in children from higher income families
  - Reason for effect is unclear

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The study determined that 19.2% of the children had hay fever, respiratory allergy, or both, as reported by the adult survey respondents. For the remainder of the talk, I will refer to these conditions as “allergies.”

Increased reports of allergy exacerbation were associated with increases in pollutant levels. For every 10 ppb increase in average summer ozone level, there was a 20% increase in the likelihood of allergy exacerbation, with a possible range of values between 15% and 26%.

Additionally, for every 10  $\mu\text{g}/\text{m}^3$  increase in average annual PM2.5 concentration, there was a 16% increase in the likelihood of allergy exacerbation, with a range of 4% to 30%.

The greatest ozone effects were seen in children from higher income families. Although the reason for this effect is unclear, the authors speculated that it might have been due to underreporting by parents in lower-income groups, or over-reporting by parents in higher income groups.

## Results (cont.)

- No associations with NO<sub>2</sub>, SO<sub>2</sub>
- Study limitations
  - Annual or summer average pollutant concentrations
  - Parental recall survey
  - Incomplete record of smoking exposures



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No associations were detected between reported allergies and annual levels of nitrogen dioxide or sulfur dioxide.

While these results show clear associations between ozone and PM<sub>2.5</sub> exposures and childhood allergies, some of the study's limitations should be noted.

The analysis was based on annual PM<sub>2.5</sub> and summer ozone concentrations, which may not reflect short-term changes in pollutant levels.

Additionally, survey reports of children's allergies were dependent on parental recall of the previous 12 months. Thus, memory limitations may have been an issue.

Furthermore, the survey provided an incomplete record of smoking exposures.

Nevertheless, this study provides useful insight into the role of air pollution exposures in childhood respiratory allergy exacerbations.

## Results Consistent with Some Prior Studies

- Previous U.S. study showed trend of increased hay fever rates with higher ozone concentrations<sup>1</sup>
- German study described association between long-term PM<sub>2.5</sub> exposure and hay fever and pollen sensitization<sup>2</sup>
- Dutch study found increased pollen sensitization near roadways with high truck traffic<sup>3</sup>

<sup>1</sup>Dockery, DW et al. 1989. Effects of inhalable particles on respiratory health of children. *The American Review of Respiratory Diseases* **139**:587-594.

<sup>2</sup>Morgenstern, V et al. 2008. Atopic diseases, allergic sensitization, and exposure to traffic-related air pollution in children. *American Journal of Respiratory and Critical Care Medicine* **177**:1331-1337.

<sup>3</sup>Janssen, NAH et al. 2003. The relationship between air pollution from heavy traffic and allergic sensitization, bronchial hyperresponsiveness, and respiratory symptoms in Dutch schoolchildren. *Environmental Health Perspectives* **111**:1512-1518.

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The findings from this study are consistent with the results of some previously conducted studies.

One prior study conducted in six U.S. cities, by Dockery and colleagues at Harvard, showed a trend toward increased hay fever rates with higher ozone concentrations. However, this trend was not significant.

A German study, published last year by Morgenstern and colleagues, described an association between long-term PM<sub>2.5</sub> exposure and increased hay fever and pollen sensitization in children.

Also, a study in the Netherlands by Janssen and colleagues found increased pollen sensitization in children near roadways with high truck, but not car, traffic.

## Conclusions



- Ozone and PM2.5 can exacerbate allergic symptoms
- Continued reduction in ozone and PM2.5 exposures are expected to
  - Reduce allergic symptoms in children
  - Reduce school absences

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In conclusion, exposures to ozone and PM2.5 can worsen childhood allergy symptoms.

Thus, continued reduction in ambient ozone and PM2.5 levels would be expected to reduce allergic symptoms and children, as well as reducing the number of school absences per year.

This concludes the Health Update; we will be happy to answer any questions. Thank you.